Soil Survey and Ecological Site Descriptions: A National Park Service Perspective

Pete Biggam
Soils Program Manager
February 2, 2012
The NPS Inventory and Monitoring Program provides guidance, funding, and technical assistance for parks to complete a set of 12 "basic" natural resource inventories.

The Soil Resources Inventory is one of these basic inventories.

The NPS recognizes that a thorough inventory and evaluation of soil resources within National Parks is needed for comprehensive management, interpretation, and understanding of park resources.

**Soil Resources Inventory**

**Background**

Soil is defined as the unconsolidated portion of the earth's crust modified through physical, chemical, and biotic processes into a medium capable of supporting plant growth. Soil properties influence the natural and the physical infrastructure of the landscape and ecosystems. The National Park Service (NPS) recognizes that a thorough inventory and evaluation of soil resources within national parks is needed for comprehensive management, interpretation, and understanding of park resources.

Soil surveys conducted throughout lands under NPS stewardship provide an orderly, on-the-ground, scientific inventory of soil resources.

The Soil Resources Inventory (SRI) includes:

- Maps of the locations and extent of soils
- Data about physical, chemical, and biological properties of those soils
- Information derived from those data about potentialities and problems of use on each kind of soil

The information is in sufficient detail for application by park managers, planners, engineers, and scientists to specific areas of concern. The Inventory & Monitoring (IRM) Program supports soils mapping and inventory based on standard terminology and techniques of the National Cooperative Soil Survey (NCSS). SRI staff assist parks with identifying needs for soil mapping, so that park objectives are met through appropriate data collection and map scales.

**Products**

Products of the Soil Resources Inventory include:

- Geospatial soils data meeting Soil Survey Geographic (SSURGO) standards
- Soil attributes, properties and interpretations exported from the National Soil Information System (NASIS) in MSAccess format
- Soil survey manuscript in both hardcopy and digital format
- Metadata following the Soil Survey Geographic Data Standard
“The Service will actively seek to understand and preserve the soil resources of parks, and to prevent, to the extent possible, the unnatural erosion, physical removal, or contamination of the soil, or its contamination of other resources”.

Excerpts from, NPS Management Policies 2006, Part 4.8.2.4 - Soil Resource Management
“Parks will obtain adequate soil surveys for the management of park resources.”

“All soil surveys will follow National Cooperative Soil Survey Standards.

Products will include soil maps, determinations of the physical, chemical and biological properties of soils, and the interpretations needed to guide resource management and development decisions.”
Additional products will include:

1) ecological site descriptions (ESD)
2) soil landscape and soil vegetation images
3) locations and documentation of all soil observations performed within or adjacent to the park.

Excerpts from, NPS Management Policies 2006, Part 4.8.2.4 - Soil Resource Management
“Only by having reliable scientific information can park managers take corrective actions before those impacts severely degrade ecosystem integrity or become irreversible”
“The Function of Soil – A NPS Perspective”

- Sustain Plant and Animal Productivity
- Maintain or Enhance Water and Air Quality
- Support Ecosystem Health and Habitation
- Protect and Preserve Our Cultural Resources and Landscapes
NPS Soil Resources Management

Our Goal

Promoting the use of soils and ecological site information in NPS decision making and making it accessible in a user-friendly way to staff and partners.
NPS Use and Application of Soil and Ecological Site Information

- Vital Signs Monitoring
- Resource Stewardship Strategies/Natural Resource Condition Assessments
- DOI Land Health Goals
- Disturbed Lands Program
- Restoration Projects
- Cultural Resources Preservation and Protection
- Park Development and Maintenance
NPS Use and Application of Soil and Ecological Site Information

- Fire Management Plans/Fuel Reduction Program
- Burned Area Emergency Response (BAER) Teams
- Distribution of Threatened and Endangered Species
- Hydric Soils and Wetland Identification and Management
- Exotic/Invasive Plants
- Exotic Plant Management Teams (EPMT)
- Interpretation/Information and Education
In the National Park Service, Ecological Site Concepts in conjunction with the Soil Resources Inventory are also being used to stratify the landscape for monitoring and assessment, interpretation of resource hazards and opportunities, and to prioritize and select management actions.
NPS Vital Signs Networks
Numerous Networks have identified the Soil Resources Inventory and Ecological Site Descriptions as a tool to help stratify the parks for monitoring purposes, and will also be looking at various vital sign indicators that can be found within these products.
Big Bend National Park Landscape Restoration Project
Disturbed Lands Restoration Project

Original intent by park hydrologist was to just remove man made earthen structures and hope the site would “fix itself”
Loamy (Hot Desert Shrub)  
R042XG738TX

1. Midgrass/Shrubland State
   1.1 Midgrass/Shrub Community  
   Historic Climax Plant Community  
   Tobosa and alkali sacaton dominate in large patches. Bare ground <40%, infrequent rills and gullies, water flow patterns are short (<6 feet)

* Grasses 75%, Shrubs 15%, Forbs 10%

T1A

2. Creosotebush/Tarbush Shrubland State
   2.1 Shrubs/Mid and Shortgrass Community  
   Creosotebush, tarbush, and mesquite increase with fragmented tobosa, burrograss and fluffgrass.
   Bare ground 40-55%, rills and gullies common and moderately active, water flow patterns are moderate (6-12 feet)

* Grasses 35%, Shrubs 50%, Forbs 15%

2.2A  2.1A

2.2 Shrub/Annual Grasses Community  
Creosotebush, tarbush, and mesquite with annual grasses, isolated burrograss and fluffgrass.
Bare ground >55%, rill formation severe, gullies common and active, water flow patterns extensive (>12 feet)

* Grasses 35%, Shrubs 50%, Forbs 15%

Legend

T1A Improper Grazing, Hydrologic alteration
2.1A Improper Grazing, Extended drought
2.2A Prescribed Grazing, Favorable rainfall

*Approximate % of weight composition by weight
Tornillo Soils

Loamy Hot Desert Shrub Ecological Site

(R042XG738TX)

10 - 13 inch precipitation zone

Calcareous alluvium parent material

Tobosa grass – Alkali sacoton plant community

Less than 40 percent bare ground

Borderline between Midgrass/Shrubland State and the Creosotebush/Tarbush Shrubland State.

Considered “Functional” and not in restoration project
Loamy Hot Desert Shrub Ecological Site
(R042XG738TX)

**Sparsely Vegetated State**

10 - 13 inch precipitation zone
Calcareous alluvium parent material
Annual invasive plant community
Greater than 90 percent bare ground

*Soil Function Drastically Reduced!*

*Not really identified in the existing State and Transition Model*
Dynamic Soil Properties observed on the Tornillo soil in 2 states of the Loamy Hot Desert Shrub Ecological Site

<table>
<thead>
<tr>
<th>Historic</th>
<th>Bulk Density (g/cc)</th>
<th>Surface stability</th>
<th>Sub-surface stability</th>
<th>EC</th>
<th>pH</th>
<th>Carbon</th>
<th>Infiltration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creosote Tarbush Shrubland</td>
<td>1.16</td>
<td>4.6</td>
<td>3.1</td>
<td>0.8</td>
<td>7.5</td>
<td>low</td>
<td>slow</td>
</tr>
<tr>
<td>Sparsely vegetated</td>
<td>1.24</td>
<td>1.9</td>
<td>2.9</td>
<td>2.1</td>
<td>7.5</td>
<td>absent</td>
<td>very slow</td>
</tr>
</tbody>
</table>
Disturbed Lands Restoration Project

The recommended strategy was to look at what state of the ESD should be considered practical to achieve as to how a restoration approach should be directed to restore an “acceptable level of function”.

Banded vegetation is an indicator of the Creosote bush/tarbush state.
Big Bend Dynamic Soil Properties and Ecological Site Project

Disturbed Lands Restoration Project

The final strategy utilized information from the Soil Resources Inventory and the ESD’s to focus on restoring soil and site stability, hydrologic function, and the biotic integrity of the sites.
Big Bend Dynamic Soil Properties and Ecological Site Project

Disturbed Lands Restoration Project

The next steps will actually look at the biotic integrity of the site, and look at soil biota (both the mega fauna and micro fauna) in treated and untreated areas.
Our Challenge

We do not want to be **DATA RICH**

Yet

**INFORMATION POOR!!**
Recently Discovered ESD’s on NPS Lands
R022BI201CA - Bedded Tephra Deposits
Lassen Volcanic National Park, California

R022BI201CA

State 1

Plant community 1.1
Sand dunes made up of black, tan, and red soils, with a sparse cover of forbs and grasses.
0-12% total cover
The NPS is interested in the development and application of the Interagency Ecological Site Description Manual that will be used by the National Cooperative Soil Survey (NCSS) to allow for standards, methods, and procedures to be used to develop, document, maintain, and archive Ecological Site Descriptions.
NPS Recommendations for the Continued Development and Enhancement of ESD’s

Need to add more information regarding the concepts of *soil change and dynamic soil properties* in the State and Transition Models to assist in identifying when a "*soil function threshold*" has been crossed and if new State or Ecological Site is present.
NPS Recommendations for the Continued Development and Enhancement of ESD’s

Need to look enhancing the **Representative Soil Features** section to provide more information regarding the relationships of the site conditions, climatic information, soil physical, chemical, and biological properties to plant physiology and subsurface symbiotic relationships with soil macro fauna and micro fauna that are occurring.
NPS Recommendations for the continued development and enhancement of the Gypsiferous ESD's:

Need to consider "marketing" the Ecological Site Descriptions in such a way that they are more easily discovered and utilized by users.

The Soil Food Web:

- **Plants**
  - Shoots and roots

- **Organic Matter**
  - Waste, residue and metabolites from plants, animals and microbes.

- **Bacteria**

- **Fungi**
  - Mycorrhizal fungi
  - Saprophytic fungi

- **Nematodes**
  - Root-feeders
  - Shredders

- **Arthropods**
  - Predators
  - Shredders

- **Protozoa**
  - Amoebae, flagellates, and ciliates

- **Animals**

**First trophic level:**
- Photosynthesizers

**Second trophic level:**
- Decomposers
- Mutualists
- Pathogens, parasites
- Root-feeders

**Third trophic level:**
- Shredders
- Predators
- Grazers

**Fourth trophic level:**
- Higher level predators

**Fifth and higher trophic levels:**
- Higher level predators
“I’ve been told you don’t like my dirt!”
We need this type of information/research on these relationships as we respond to emerging issues such as climate change and increased energy development on federal lands that will require a restoration component.
What about subaqueous soils and ecological sites?
Everglades National Park

The largest subtropical wilderness in the United States, it contains the southern 25 percent of the original Everglades marshland region of southwestern Florida. It is visited by one million people each year, and it is the third-largest national park in the lower 48 states. It has been declared an International Biosphere Reserve, a World Heritage Site, and a Wetland of International Importance, only one of three locations in the world to appear on all three lists.
Everglades National Park

- 137 miles (220 km) of coastline
- 484,200 acres (196,000 hectares) in Florida Bay and the Gulf of Mexico
- 572,200 acres (231,500 hectares) of sawgrass/freshwater marsh
- 230,100 acres (93,100 hectares) of mangrove forest
- 220,000 acres (89,000 hectares) of coastal areas (Cape Sable, river headwaters, etc.)
Everglades National Park

6,600 acre soil restoration project underway to mitigate impacts from past agricultural activities and ultimately return it to a marl prairie wetland.
Issues to Be Addressed for Florida Parks

- Ability to properly identify, describe, classify, and delineate subaqueous soils and provide applicable, meaningful interpretations on their potential use and management for over 1 million acres or more.

- This is not an issue unique to NPS
Issues to Be Addressed for Florida Parks

Ecological Site Descriptions and issues with exotics and invasive plants, and anthropogenic impacts need to be considered in the state and transition models.
Issues to Be Addressed for Florida Parks

Dynamic Soil Properties and concepts on “Soil Thresholds and Soil Change” need to be considered to meet management needs.